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NOTES ON THE DESCRIPTION OF LAND FORMS.—III.

MORPHOLOGIE DES BÖHMERWALDES. By Prof. Dr. H. Mayr. (*Landeskundl. Forsch.* Geogr. Gesellsch., München. Heft 8, 1910, 123 p.) This painstaking and largely inductive study of a region, concerning which little modern physiographic information is to be had, may be taken as typical of a way of treating land forms which can be called the method of uncorrelated explanations; for, following the general genetic principle of the action of internal against external forces, announced in the introduction, the author proceeds to develop a number of theoretical and explanatory considerations, but without correlating them in a comprehensive evolutionary scheme. Detailed chapters on geology, climatology and hydrography occupy 77 pages; "Landschaftsformen" are treated in the remaining 44, with such sub-titles as tectonic valleys, erosional valleys, ridges and domes, etc.

The essay is of rather difficult reading, because so many independent and unexplained items are presented before the generalizations that combine and explain them are reached; this being a characteristic of the inductive method, in contrast to a method that begins with a concise explanatory statement, in view of which all items afterwards mentioned may be given their proper place and meaning as soon as they are encountered. The plan of treatment adopted by Mayr is, moreover, strikingly unlike that followed by Demangeon in his essay on the Limousin, reviewed in these notes last November, in which the scheme of the cycle of erosion was so fully adopted and so effectively used; for in Mayr's study the considerations usually associated with that helpful scheme are almost completely excluded. Their exclusion is to my reading a disadvantage, for it makes the descriptions of land forms less clear and the explanations given to them less secure. The lack of clearness and of security, as characteristic of the method of uncorrelated explanations, deserve special scrutiny.

The lack of clearness in Mayr's descriptions is seen in the uncertainty that remains in the reader's mind as to whether the generally subdued and waste-covered forms of the Böhmerwald highlands possess those rounded summits and moderate inequalities of height that characterize the late stage of a single cycle of erosion, in which all traces of forms developed in a former cycle are lost; or whether the highlands exhibit, as is so often the case in regions of greatly deformed and deeply eroded structures, broad-topped remnants of old forms developed in an earlier cycle, separated by young or submature valleys eroded during the current cycle. These alternative interpretations are worth examining, because the conception of the landscape that the reader gains from the observer's description must vary, according as one or the other interpretation is adopted.

The region consists for the greater part of schists and gneisses, striking northwest-southeast, and of massive granites. The chief deformations and intrusions are regarded as not later than Carboniferous, with subordinate and imperfectly specified dislocations of Tertiary date. Hence, as far as time is concerned, there has evidently been an abundance of it, since the period of strong mountain building and during the great degradation that the region has suffered, for the passage of several cycles of erosion, separated by successive uplifts without significant deformation. The question, however, that here stands open for the geographer to resolve is not whether successive cycles of erosion have taken place in the geological past, but whether traces of more than one cycle of erosion are visible in the forms of the geographical present. The readers of Mayr's essay have to try to answer this question by appealing, not to the facts, but to an expert's description of the facts, and it is the uncertainty which remains after this appeal is made which must be regarded as a lack of clearness, and hence as a disadvantage of the method of uncorrelated explanations.

The sufficiency of a single cycle of erosion to explain the existing forms of the Böhmerwald is implied in the statement that there is a gradual transition from the higher ridges and hills along the Bavarian-Bohemian boundary northeastward to the peneplain of middle Bohemia (p. 2) ; for from this it might be fairly inferred that the greatly degraded forms of the Böhmerwald are the subdued one-cycle residuals of the most resistant rocks in a region which, in its areas of weaker rocks farther northeast, has reached advanced old age. The sufficiency of one cycle is again implied by the statement that the systematic decrease of fall down stream in the graded rivers is to be explained by the advanced age of the mountains (108) ; for if, on the contrary, the valleys were of two cycle origin, a headwater stream might still retain the faint fall of a former old age, after a middle stretch had gained a steeper fall in a newly deepened valley of revived erosion. The same implication is once more found in the explanation—of doubtful validity, as will be shown below—of the so-called tectonic valleys (81-), which are treated as owing their form chiefly to the deformation by which the mountains were created; for if any forms due to initial deformation still remain, prolonged erosion in several cycles separated by successive uplifts becomes very improbable, if not altogether impossible.

On the other hand, the highlands are described as monotonous (6, 115), with flat-topped ridges (83, 118), often having summits of similar altitude (121), and in one locality expanding in a plateau-like surface of "unexplainable origin" (117). All these features so strongly suggest that a former cycle of erosion witnessed the production of a peneplain, which is now elevated and elaborately dissected in the current cycle of Böhmerwald evolution, that one would be justified in tentatively accepting so plausible a conclusion, were it not that no mention of it is made by the author. Absence of mention can hardly be ascribed to unfamiliarity with the idea of cycles of erosion on the author's part, for he occasionally uses terms, such as mature (*ausgereift,* 109), that go with the cycle scheme; and he explicitly recognizes the occurrence of the peneplain of middle Bohemia, as above noted; and, as is well known, a peneplain is the penultimate member of the series of forms evolved in an undisturbed cycle of erosion. Hence, absence of mention of two-cycle forms would seem to indicate that the author did not regard the monotonous highland landscape with its flat-topped ridges as indicative of two-cycle explanation. But uncertainty must still remain in the reader's mind even on this point, because the author does not contradict the implication of two cycles, given in his empirical descriptions, by an explicit avowal of belief in the sufficiency of one cycle, and support his avowal with good reasons therefor. It is this uncertainty of meaning—the bane of many geographical descriptions—that the adoption of any thorough-going scheme of correlated explanations does so much to avoid.

Before considering the lack of security in uncorrelated explanations, let it be explicitly recognized that explanatory descriptions of any kind have been condemned by some conservative empirical geographers, because of the possible insecurity of their explanations. In view of this, it behooves every geographer who prefers an explanatory to an empirical method, to lessen its chances of error by every means in his power. One of the best means to this end is found in the correlation of explanations, for it may be fairly urged that if the separate explanations of many different facts can all be reasonably united in a comprehensive explanatory scheme, the probability of their correctness is thereby much increased. On the other hand, any one of a number of uncorrelated explanations may go astray, without disarrangement of the rest, and therefore with small chance that either the author or his readers can surely detect where the error lies. It is precisely this principle that is illustrated by reference to Mayr's treatment of the valleys of the Böhmerwald. Let it, however, be said at the outset of this discussion that the present reviewer has no personal acquaintance with the region concerned, and that the discussion is therefore limited to Mayr's presentation of the facts. Such a discussion may perhaps be called academic; but whatever name it deserves, it touches a question of method that is of fundamental importance in geography to-day, now that the treatment of land forms is passing from the old-fashioned empirical methods, to the newer fashioned, rational, genetic, explanatory methods. No one can read the current geographical journals without becoming aware that this transition is going on, a transition that is bringing about the establishment of the same evolutionary philosophy in geography that is already so strongly established in other sciences. We are indeed rather late in making a change that our geological and biological colleagues have made already; but we are surely making the change, and it is well that we should make it with full understanding of its difficulties and its advantages. The clearness and security of any method of explanatory description therefore deserve examination.

The question now before us is whether the facts regarding the valleys of the Böhmerwald are more safely presented to the reader by what is here called the method of uncorrelated explanations than by a method of correlated explanation. Following the method of uncorrelated explanations, as it is employed by Mayr, we learn that the valleys of the Böhmerwald are of two kinds, tectonic and erosional. The chief tectonic valleys are explained as owing their origin to the great Carboniferous mountain-making deformation of the region (p. 81), and as therefore being closely related in trend to the structure of the highlands (84), but unrelated in size to the streams that drain them, and little affected by the work of their streams (81). Three examples of this kind occurring in steep monoclinal gneiss and mica schist (82) are characterized by a direct course between pronounced ridges of uniform lateral slope (84). On the other hand, the erosional valleys are regarded as essentially the work of water (80); but the valleys heads have been modified by ice (90-102). The chief erosional valleys are characterized by indifference to the strike of the rocks (107), by their small breadth (107), and by side slopes that steepen downwards to their base (83).

The difficulty in accepting these contrasted but uncorrelated explanations as safe and sufficient, is due to the absence of various considerations that must come to mind if one attempts to re-state the explanations in terms of a more fully correlated scheme of treatment. Under such a scheme, the principles of the life history of rivers and their valleys show that trough-like depressions may be initiated by deformation, but that such initial forms will be changed into true valleys by the processes of ordinary erosion. They show further that, while young valleys may be narrow and steep-sided, old valleys must be broad floored between faint side slopes and low divides; that consequent valleys, as Powell called them, are incised beneath the troughs and slopes of initial deformation, and that subsequent valleys are developed, as Jukes clearly explained, by headward erosion along belts of weak structure quite independent of initial form; again, that in regions of deformed structure and repeated uplift, subsequent valleys (including under this name, valleys eroded in a second cycle by revived subsequent streams, as well as valleys excavated in a first cycle by the headward erosion of such streams) may come to outrank consequent valleys; this important principle deserving the name of Löwl's law, after its first enunciator; that valleys which are eroded by streams whose courses are inherited, as Shaler phrased it, from an overlying simpler structure on an unconformably underlying complicated structure—the epigenetic streams of Richthofen, or superimposed streams of Powell, shortened to superposed by McGee—manifest marked indifference to structural strike; and finally that the form of a region, as initiated by deformation, will be unrecognizably changed after a lapse of such a measure of time as the Cretaceous or the Tertiary period, because all the valleys will then have widened to the point of consuming the initial elevations.

With these well established characteristics of rivers and valleys in mind, it is evident that tectonic valleys, as defined by Mayr, correspond to little modified troughs of initial deformation in the above terminology, but it is by no means clear that the three examples, described as tectonic valleys in the Böhmerwald, are really troughs of initial deformation little modified by their streams. Surely the occurrence of these valleys in belts of gneiss and schist of Carboniferous deformation throws great doubt on such an origin. Are the valleys not more likely mature subsequent valleys of the *n*th cycle, their breadth being determined by the breadth of the weak structural belts along which they have been worn out, and therefore having little relation to the size of their streams; their direct course being determined by the direct trend of these guiding structural belts; and the uniform slope of their sides being a natural result of normal weathering and creeping on appropriate structures? But these suppositions cannot be tested, because no sufficiently detailed statements are made concerning the rocks of the valley floors and of the enclosing ridges.

As to erosional valleys, it is surely not possible to discriminate them from tectonic valleys on the basis of narrow form and steep sides. Valleys that are eroded on weak rocks will gain a mature breadth and openness, while valleys eroded in hard rocks still retain a youthful narrowness; but in time even the hard-rock valleys will be worn wide open. It may well be that the narrow valleys of the Böhmerwald are not tectonic; but it does not follow at all that the broad valleys are not erosional.

The moral of all this is, that as long as a discussion of tectonic and erosional valleys, or of any other groups of forms, proceeds independently of the generalized treatment of the region in which they occur, the discussion may seem acceptable, even though it is really insufficient. When such a discussion is tested by paraphrasing its results in the systematic terminology of a more comprehensive scheme, its insufficiency, if it be insufficient, will be brought forward. Hence, when a young geographer chooses and adopts one from among the several extant methods available for the description of the landscapes that he studies, there is a matter of some scientific importance at stake, and not merely a matter of tradition, of accidental habit, or of personal preference. The matter has indeed an objective importance, for the method of treatment will react upon and greatly influence the aim and scope of observational work. There is really a large principle here at stake; for the choice of method is really a choice between conservatism and progress. If the choice be in favor of the older fashioned empirical method, in the hope of avoiding the dangers of explanatory methods, then one must abandon all the progress made in the explanatory interpretation of land forms during the last century, especially during the last half-century, when the leaders among our western geologists gave so high a standing to American geomorphology. If, on the other hand, the choice be in favor of an explanatory method, then all these helpful interpretations may be employed, and new ones may be searched for; but in this case let the explanations of the chosen method be as thoroughgoing and whole-souled as possible; let piece-meal work be avoided in favor of correlated work, in the conviction that the more fully all explanations are harmoniously combined, the greater is their probability of correctness, and the safer are the descriptions that are phrased in explanatory terms.

W. M. DAVIS.

GEOGRAPHICAL RECORD

THE AMERICAN GEOGRAPHICAL SOCIETY

THE DECEMBER MEETING OF THE SOCIETY. A regular meeting of the Society was held at the Engineering Societies' Building, No. 29 West Thirty-ninth St., on Tuesday Evening, Dec. 20, 1910. Vice-President Greenough in the chair.

The following persons recommended by the Council, were elected to Fellowship:

Samuel R. Betts,
W. C. Brown,
J. Hull Browning,
Robert J. Collier,
George B. Dexter,
P. Maxwell Foshay, M.D.
William Burton DeGarmo, M.D.,
Rev. Milo Hudson Gates,
Samuel E. Hoffman,
Carl Otto Lampland,
Enoch P. Lawrence, M.D.,
John MacGregor Littell,
Winfred R. Martin,
Dave H. Morris,
John Neilson,
Miss Blanche Nevin,
Adolph S. Ochs,
Pehr Olsson-Seffer, Ph.D.,
Frederic Courtland Penfield,
John A. Power,
Edwin N. Sanderson,
Louis Agassiz Shaw,
Henry A Sinclair,
Miss Henrietta C. Wemyss.

The Chairman then introduced Mr. C. J. Blanchard, of the U. S. Reclamation Service, who addressed the Society on "The Arid Regions of the United States and the Reclamation Service." A large number of stereopticon views were shown. Mr. Blanchard described a number of the more important enterprises and showed the transformation that is being made in parts of the arid area which have been turned into the finest of farm lands. Some of his striking pictures presented the same areas before and after the change wrought by the introduction of water.

The Society then adjourned.

AWARD OF THE SOCIETY'S MEDALS. The Charles P. Daly Medal for Geographical Research has been awarded to Dr. Grove K. Gilbert, the distinguished geologist of the U. S. Geological Survey. The inscription on the medal